Designated Original

APS

EA-03-009

Palo Verde Nuclear Generating Station

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102-05094-CDM/SAB/RJR
April 22, 2004

Secretary,
Office of Secretary of the Commission
U.S. Nuclear Regulatory Commission
ATTN: Rulemakings and Adjudications Staff
Washington, DC 20555-0001

References: 1. APS Letter 102-05075-CDM/SAB/RJR, "Relief Request No. 25 – Request for Relaxation of First Revised NRC Order EA-03-009, Section IV.C.(5)(b) Requirements for CEDM Nozzles," dated March 19, 2004.

2. APS Letter 102-05085-CDM/SAB/RJR, "Response to Request for Additional Information - Request for Relaxation of First Revised NRC Order EA-03-009, Section IV.C.(5)(b) Requirements for CEDM Nozzles," dated April 16, 2004.

Dear Sirs:

Subject: Palo Verde Nuclear Generating Station (PVNGS)
Units 1, 2 and 3
Docket No. STN 50-528, 50-529 and 50-530
Response to Second Request for Additional Information - Request for Relaxation of First Revised NRC Order EA-03-009, Section IV.C.(5)(b) Requirements for CEDM Nozzles

In Reference 1 above, Arizona Public Service Company (APS) requested relaxation from First Revised NRC Order EA-03-009, Section IV.C(5)(b). In Reference 2, APS provided responses to NRC questions provided on April 12, 2004. The enclosure to this letter contains APS' response to the NRC's second request for additional information transmitted to PVNGS via e-mail on April 16, 2004.

APS requests review and approval of this request for Unit 1 prior to Mode 2 entry from the Unit 1 refueling outage. Mode 2 entry is currently scheduled for May 2, 2004. APS also requests that this relaxation be approved for Unit 2 and Unit 3 prior to September 2004.

This letter contains no new commitments. Should you have any questions, please contact Thomas N. Weber at (623) 393-5764.

Rec'd 6/16/04
DCD A101

Sincerely,

David J Mauldin

CDM/SAB/RJR/

Enclosure Response to the Second Request for Additional Information for Relaxation of First Revised NRC Order EA-03-009, Section IV.C.(5)(b) Requirements for CEDM Nozzles

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Enclosure

Response to the Second Request for Additional Information for Relaxation of First Revised NRC Order EA-03-009, Section IV.C.(5)(b) Requirements for CEDM Nozzles

Response to the Second Request for Additional Information for Relaxation of First Revised NRC Order EA-03-009, Section IV.C.(5)(b) Requirements for CEDM Nozzles

Background

On March 19, 2004 APS requested relaxation from First Revised NRC Order EA-03-009, Section IV.C(5)(b). On April 16, 2004, APS provided responses to NRC questions received on April 12, 2004. This enclosure contains APS' response to the NRC's second request for additional information transmitted to PVNGS via e-mail on April 16, 2004.

NRC Question 1

References:

1) Palo Verde Nuclear Generating Station (PVNGS), Docket Nos. STN 50-5328, 50-529, and 50-530, License Nos. NPF-41, NPF-51, and NPF-74, Additional Information Regarding Relaxation Request to NRC Order EA-03-09, dated March 21, 2003.

2) Palo Verde Nuclear Generating Station (PVNGS) Unit 3, Docket No. STN 50-530, Response to Request for Additional Information Regarding Relaxation Request to NRC Order EA-03-009, dated April 2, 2003.

3) Westinghouse document, WCAP-16044-P, "Structural Integrity Evaluation of Reactor Vessel Upper Head Penetrations to Support Continued Operation: Palo Verde Unit 3."

4) Safety Evaluation for Palo Verde Unit 3, "Order (EA-03-009) Relaxation Request, Proposed Alternative Inspection for Reactor Pressure Vessel Head Inspections for CEDM Nozzles (TAC MB7855)," dated April 17, 2003.

5) Palo Verde Nuclear Generating Station (PVNGS) Units 1, 2, and 3, Docket No. STN 50-528, 50-529, and 50-530," Relief Request No. 25 - Request for Relaxation of First Revised NRC Order EA-03-009, Section IV.C.(5)(b) Requirements for CEDM Nozzles," dated March 19, 2004.

Reference 1, page 4 states: "In order for APS to comply with this requirement, APS would need to develop new remote tooling or remove and reinstall a large number of funnels. Personnel radiation exposure for performing a manual PT would be excessive. The next outage is due to start on March 29, 2003, and there is not sufficient time for planning this inspection option."

Reference 2, which states that the Relaxation Request is applicable to Unit 3 only, makes the same statement discussed above with respect to planning time for remote tooling.

Reference 4, granted relaxation due to hardship, in part due to the time period involved with planning for the remote inspection for Unit 3 on page 6.

Reference 5 (which applies to all three units) states: "Due to the location and proximity of the funnels to each other and limited space, performing a surface examination on the outside diameter of the CEDM nozzles would be a high dose manual process. In order for APS to comply with this requirement for all the CEDM nozzles, APS would need to develop new remote tooling or remove and reinstall a large number of funnels.

Since Reference 4 granted relaxation due to hardship, in part due to the time period involved with planning/development of tooling for the remote surface examination for Unit 3, please explain in detail what planning has been completed to date (since your letter dated March 21, 2003) and your schedule to deploy remote tooling for a surface examination of the OD section of the CEDM nozzles. This discussion and the appropriate commitments should be added to the Relaxation Request.

APS Response

Although the granting of the relaxation for Unit 3 refueling outage number 10 (U3R10) may have been given in part due to the time period involved with planning/development of tooling for the remote surface examination for Unit 3, it was clear to APS that the crack growth analysis provided the assurance of safety until the next inspection. The following statements were made by the NRC on page nine and ten of the relaxation "...the required inspection of the remaining portions of the CEDM nozzles would provide little or no increase in the level of quality and safety" and "Any future crack growth analysis performed for this and future cycles for RPV head penetrations must be based on an acceptable crack growth rate formula." These statements made it clear that crack growth rate is an acceptable means for determining the extent of inspection required by the NRC Order.

Developing tooling and methods to examine the full length of the nozzle is only needed if the crack growth analysis determined that the extent of inspection is not sufficient.

NRC Question 2

Reference 1, (which applies to all three PVNGS units) page 2 states: "Experience gained from the previous two UT examinations of the CEDM nozzles completed at PVNGS (Unit 2 Refueling Outage 10 and Unit 1 Refueling Outage 10 in the spring and fall of 2002, respectively) has shown that scanning become impractical and ineffective from approximately 0.6 inches above the top of the nozzle's chamfer face to the bottom of the nozzle....."

Reference 1, page 3 states: "The inspection method deployed at PVNGS provides coverage from 2 inches above the J-groove weld to 1.3 inches below the J-groove weld.

The area not covered by this exam has been evaluated and determined to be a low stress zone. The area of the CEDM nozzles that is not inspected is more than 1.3 inches below the J-groove weld.

Reference 3, provides Unit 3 hoop stress vs. distance plots showing inspection zones of 1.3 inches below the weld.

Reference 5, (which applies to all three PVNGS units) page 4, Tables 1 and 2, indicate that the minimum coverage below the J-groove welds is 0.20 - 0.45 inches.

Taking into consideration your statement the "Experience gained" at Units 2 and 1 during previous inspections, please explain the difference in coverage presented in References 1, 3, and 5. The discussion should also assess the adequacy of the data provided to date.

APS Response

The methodology used in the crack growth calculation (below the weld) in Reference 5 reflects the latest methodology used in similar relaxation request submittals for other plants. The data provided in Reference 5 is based on a more conservative methodology and represents an extension of those provided in Reference 3. The data provided in Reference 5 superseded those provided in Reference 2.

The inspection coverage shown in Tables 1 and 2 of Reference 5 represents the minimum distance required such that any undetected flaw would not reach the bottom of the weld in at least one fuel cycle (~ 1.5 EFPY). It is expected that the actual inspection coverage would at least equal to or exceed that required in Reference 5.

The CEDM UT inspections performed during U2R10 and U1R10 were done prior to the issuance of the NRC Order in February of 2003. When the NRC order was issued it required data to be taken from 2 inches above the j-groove weld to the bottom of the CEDM nozzle. The experience gained during the U2R10 and U1R10 outage was that data could not be taken all the way to the bottom of the CEDM nozzles and that scanning became impractical and ineffective approximately 0.6 inches above the chamfered face. Therefore a relaxation was requested. The extent of coverage was not recorded during those outages, however it was initially estimated using design drawings that 1.3 inches of coverage was available.

The Unit 3R10 CEDM inspections were completed in April of 2003. Subsequent to the inspection in Unit 3, APS became aware of issues at other facilities where inspection distances were reduced due to oversized J-groove welds. APS performed a review of the U3R10 data and verified that the inspection distances were greater than the minimum required inspection distances identified in Table 2 of Reference 5.

NRC Question 3

Reference 2, (which applies to Unit 3) states, " It was determined using plant specific flaw analysis that it would take an axial crack with a crack tip ½ inch below the weld, approximately 5.8 EFPY to extend to a point of contacting the pressure boundary J-groove weld.

Reference 3 provides a stress corrosion cracking prediction for the 51.5 degree uphill side, of 5.8 EFPY for Unit 3.

Reference 4 granted relaxation in part to the 5.8 EFPY time to cracking with the expectation that this time bounded all other CEDM nozzles as the most conservative.

Reference 5 provides a stress corrosion cracking prediction for the 51.5 degree downhill side of 2.4 EFPY. It also shows that more severe cracking may be occurring with predictions as low as 1.7 EFPY for Unit 3.

Please provide information that shows that the data provided under Reference 2 bounded all CEDM nozzles. Secondly, please explain the differences in examination coverage, stress analysis and crack predictions for all three PVNGS units.

APS Response

The methodology used in the crack growth calculation (below the weld) in Reference 5 reflects the latest methodology used in similar relaxation request submittals for other plants. The data provided in Reference 5 is based on a more conservative methodology and represents an extension of those provided in Reference 3. The data provided in Reference 5 superseded those provided in Reference 2. The initial axial thru-wall flaw size assumption, stress intensity factor expression and the location for the upper extremity of the initial flaw used in the crack growth predictions of Reference 5 are different from those used in References 1, 2 and 3. The differences in the methodology used are discussed below:

Initial Axial Through-Wall Flaw Size

The axial through-wall flaw is conservatively postulated in Reference 5 with its upper crack tip located at the end of the inspection zone, while its lower crack tip is assumed to be located where the hoop stress drops below 0 ksi on either the inside or outside surface of the CEDM penetration nozzle. The initial through-wall flaw length postulated in References 1, 2 and 3 are based on a flaw length that exceeds the stress intensity factor threshold of 9 MPa$\sqrt{m}$ shown in the recommended Alloy 600 crack growth curve in MRP-55 Rev. 1. The initial flaw length postulated in Reference 5 is in general longer than those used in References 1, 2 and 3.

Stress Intensity Factor Expression

The stress intensity factor expression used in Reference 5 is based on an axial through-wall flaw in a cylinder while that used in References 1, 2 and 3 is based on a through-wall flaw in a flat plate. By reviewing the stress intensity expressions for both models, it can be seen that the resulting stress intensity factor utilizing the cylinder model would be higher than that obtained with the flat plate model. However, it should be noted that the use of the flat plate model in References 1, 2 and 3 already produces a very conservative estimate of crack propagation below the weld. This is because the region of interest is below the weld. It is not subjected to any differential operating pressure hoop stresses, but only the residual stresses resulting from the welding operation. In this situation, as the crack propagates, the stresses on the crack face are expected to relieve completely. Using either the flat plate or the cylinder model subjected to stress loading instead of displacement loading ignores the effect of such stress relief. Nevertheless, additional conservatism was introduced in the crack growth predictions in Reference 5 by using the stress intensity factor expression for a through-wall flaw in a cylinder subjected to stress loading.

Upper Extremity of Initial Flaw

The upper extremity location for the initial through-wall flaw in Reference 5 is postulated at the end of the minimum required inspection coverage zone tabulated in Tables 1 and 2 of Reference 5. This location is selected such that any undetected flaw in the area not inspected would take at least one fuel cycle (~1.5 Effective Full Power Years) to reach the bottom of the J-groove weld. As for the upper extremity location postulated in References 2 and 3, it was arbitrarily set at 0.5 inch below the weld because the stress levels at this distance in general, are too low to generate significant crack growth. The postulated location for the upper extremity of the initial flaw in Reference 5 is more conservative because the driving force for crack propagation is larger towards the J-groove weld region.

Based on the more conservative methodology used in Reference 5, the time required for an undetected flaw in the region not inspected is expected to be shorter than those shown in Reference 2.

The differences in the examination coverage, stress analysis and crack predictions for all three PVNGS units are discussed below:

Examination Coverage

The examination coverage for all three units is expected to be different based on plant specific head penetration geometry and J-groove weld configurations. Tables 1 and 2 in Reference 5 provide the minimum inspection coverage required for each unit. If the actual inspection coverage exceeds those required in Tables 1 and 2, any undetected flaw in the region not inspected would not reach the bottom of the weld before the next inspection.

Stress Analysis

There is no difference in the methodology used in the stress analysis between the three units. The stress analysis results that are used in the crack growth predictions presented in Reference 5 are the same for Palo Verde Units 1 and 2, but different from that for Palo Verde Unit 3 due to different upper head penetration geometry. This is because the penetration nozzle wall for Palo Verde Unit 3 is thicker than that in Units 1 and 2. In addition, the methodology used in the stress analysis to support the data presented in References 1, 2, 3 and 5 is the same.

Crack Growth Predictions

There is no difference in the methodology used in the crack growth predictions in Reference 5 between all the three units. The crack growth predictions are the same for Palo Verde Units 1 and 2, but different from that for Palo Verde Unit 3. This is because the penetration nozzle wall for Palo Verde Unit 3 is thicker than that in Units 1 and 2. However, the methodology used in the crack growth calculations to support the data presented in References 1, 2 and 3 is not the same as that used in Reference 5 as discussed above.

References

1. APS letter 102-05075, "Relief Request No. 25 – Request for Relaxation of First Revised Order EA-03-009 Section IV.C(5)(b) Requirements for CEDM Nozzles," dated 03/19/04.